

## Tevatron Studies

M. Church 12/03/01

updated 12/28/01

### Develop beam scraping techniques: D. Still

-- 1 shifts

-- Several studies require a transversally narrow beam, or beam whose emittance is known relatively. The scrapers can also be used to calibrate the FW's.

-- MC's suggestions: 1) Set up sequencer aggregate with C48 and C10 to turn on E0 dogleg, scrape a user-specified fraction of the beam, and then turn the E0 dogleg off. We need to be able to do this at 150 GeV and 980 GeV. We need to be able to do this horizontally and vertically. 2) We need a procedure to measure the beam emittance with the E0 collimators. Vertical is unambiguous, but since  $D_x=2.1\text{m}$ , horizontal mixes momentum width with transverse width. Perhaps "prescraping" with high dispersion collimator can eliminate some ambiguity. Uncoalesced beam has small momentum width, but appears to be longitudinally unstable, even at low intensities. For vertical, 95% normalized emittance is given by  $\epsilon = 6 * \gamma_r * (y_{32\%} - y_0)^2 / \beta$  where  $y_0$  is the collimator position at the beam extinction point and  $y_{32\%}$  is the collimator position where 32% of the beam is scraped. This assumes the distribution is bi-gaussian, which is the standard assumption for the FW's. This is a reasonable assumption if the beam was injected with relatively small injection oscillations.

-- *to be specified by D Still*

## Commission Flying Wires: M. Church

### -- 8 shifts

-- These studies are to be done in conjunction with RF&I group, S Pordes and others. Start with coalesced protons at 150 GeV; then repeat at 980 GeV; then start adding more proton bunches. Then start on pbars.

-- Prerequisites: Get basic system parameters (geometry, fly speed, wire fly radius, wire size and material, cable types, PMT type, PMT base type, scintillator type, ....). Do basic calculations to understand what we expect to see when the wires are flown.

1) Commission pulser (LED on scintillator). Then see if PMT's are affected by Tevatron stray fields.

2) Start with coalesced P1 at 150 GeV. Measure emittance vs. gate time and gate width. Measure emittance vs. HV. Measure emittance vs. local position bump. Measure emittance vs. wire speed. Observe local signals in all cases. Calibrate with E0 collimator scan and SBD. Place collimator at edge of beam downstream of FW's. Does this change FW profile? (Do FW scintillator paddles see delayed secondaries?). Introduce global coupling. How does this effect the measured emittance? (both with collimators and FW's)

3) Verify that the FW give consistent results for each of P1 – P36 individually.

4) Measure emittance of P1 while loading in P1 – P36. Observe local signals at E1. Are there signs of PMT saturation.

5) .....

## F0, A0, C0 aperture scans: Tev group

### -- 1 more shift

-- The purpose of this study is to determine if the aperture at these locations corresponds to the "ideal" aperture. Also, use these scans to document any anomalously large local tune shifts.

-- Prerequisites: Test local position and angle bumps. Obtain theoretical physical apertures from drawings, and incorporate into MAD model.

-- Do studies at 150 GeV on central orbit. Measure orbit. Scrape beam down to "pencil" (scrape ~80% of beam). Measure emittance, if FW's are working. Do position, angle, 11 and 49 3-bumps. Stop scan when only a few % of beam is lost.

(Note: measurements completed at C0. See Elog entry 12/11/01. F0 scans part of "investigate pbar momentum aperture limit")

Track down source of 150 GeV tune drift: J. Annala

-- ? shifts

-- MC's ideas are: 1) Possibly a magnet in the Tevatron is "broken". 2) Is this related to conning tower torlon problems? For example, ground fault current changes as a function of time as leads change temperature? 3) Measure tune drift after standard ramps (6 ramps to 980 GeV + 1 squeeze). 4) Measure tune drift after standard ramps, but with b2 correction off. 5) Measure tune drift after 1 ramp to 980 GeV + 1 squeeze. 6) Measure tune drift after 6 ramps to 900 GeV. 7) Measure tune drift with b2 correction on and with local bumps at straight sections.

-- *to be specified by J Annala*

Measure BPM response to coalesced beam: M Church

-- 3 shifts

-- The response of the RF modules to coalesced beam is not well known. (*does anyone know of any documentation on this?*) It would be operationally advantageous to be able to make trustworthy orbits with coalesced beam. The purpose of these studies is to document this response.

-- At 150 GeV, take good uncoalesced beam orbit. Then take orbits with coalesced P1 at varying intensities, documenting bunch length, intensity, and satellite intensity. Use 7 bunches at 3-9 turns. (*ask IK if coalescing needs separate tuneup for each intensity*) At a fixed intensity, take orbits while varying the RF voltage (*how to do this?*), documenting bunch length, intensity, and satellite intensity. Repeat at 980 GeV. Tabulate which BPM's see simultaneous protons and pbars during collisions and determine if BPM proton port sees pbars by taking orbits at different cogging values (end-of-store study).

Commission longitudinal dampers: J. Steimel, CY Tan

-- 1 more shift

-- prerequisites: Complete the hardware.

-- Mode 0 and mode 1 dampers have been tested for P1-P36 coalesced protons at 150 GeV. Require testing at 980 GeV to find optimum gain. Require testing for uncoalesced beam. Possible hardware problem exists for mode 1 phase adjustment

-- *to be specified by J. Steimel*

Commission transverse dampers: J. Steimel, CY Tan

-- ? shifts

-- Initial plan will be to go after a single line....

-- *to be specified by J. Steimel*

Fix MI → Tevatron Energy match: B. Hanna

-- 2 shifts + parasitic

-- New accurate DCCT's with readbacks being installed on Tevatron and MI bend bus. This will allow us to determine if currents are not well regulated. Varying MI timeline (try different cycles before the \$2B) may tell us if there is a hysteresis effect. Mismatch for pbars on \$2A's may in fact be due to 1st turn momentum scraping.

-- *to be specified by B. Hanna*

Measure pbar lifetime at 150 GeV on pbar helix vs chromaticity:

-- 1 shift

-- Has this already been done? Use pbar only. This may provide justification for differential chromaticity circuits.

-- *to be specified by ??*

Commission Proton Qualifier: B. Hanna

-- complete

-- Code in the MI FBI is used to implement a proton qualifier, which provides an input signal to the c289 Beam Synch Qualifier kludge module in the MIBS hardware. See Tevatron web page for documentation. User interface is currently via parameters.

-- *to be specified by B. Hanna*

Commission T41 (BPM test program): R. Tokarek

-- 1 shift

-- This program is almost ready. Students should take some time to use this program and provide feedback to R. Tokarek. Eventually I would like to use this program to start getting the BPM's all relatively well calibrated (<20%?).

-- *to be specified by R. Tokarek*

Implement TBT capability in all BPM houses: R. Tokarek

-- ???

-- Prerequisites: Write new T42 code. Modify CLIB code (B Hendricks).

-- Currently, all houses have the TBT firmware installed in the the BPM  $\mu$ p's. E1 and E2 have the "old style" firmware, and currently work with T42. The other houses have the "new style" firmware, and currently don't work with any software. TBT capability in every house will allow us to do lattice measurements with the E17 vertical pinger (commissioned recently by D. Bollinger) and E48 kicker.

-- *to be specified by R. Tokarek*

Measure FBI offsets during ramp and cogging: M. Church

-- 1 shift

-- There is a large change in the pbar FBI background signal during acceleration. Is this an instrumental effect that gives an incorrect pbar intensity? Accelerate 36 coalesced protons with a "known" # of pbars (ie, 0) and record signals.

Understand source of B0 muon chamber losses: D. Still

-- 1 shift + several end-of-store studies

-- Adjust F17 collimator angle; try using high momentum collimators; measure beam center in order to get distance from beam center to collimators .....

-- *to be specified by D Still*

Adjust IR positions: Tev group

-- 1 shift

-- D0 positions are reported to be within  $\pm 5$ mm and  $\pm 1$ mrad. CDF positions are still unknown, but correctors are running hard. IR position can be adjusted up to  $\pm 1$ mm by moving L.B. quads cold if necessary.

Commission Synch Lite: C. Brown

-- ? shifts

-- This system is currently recording data, but what does it mean?

-- *to be specified by C. Brown*

### Commission CPM: C. Brown

-- ? shifts

-- This system is currently recording data, but what does it mean? Recorded BPM positions show long term and short term drifts which are not seen in CDF and D0 detectors.

-- *to be specified by C. Brown*

### Measure BPM offsets: C. Brown

-- 3 shifts

-- The BPM offsets can be checked at the individually powered quads, of which there are about 20. Measure orbit deviation as a function of quad gradient, for different local bump sizes. Similar in principle to tickling measurement. Could have accuracy of 1-2mm.

-- *to be specified by C. Brown*

### BLT analysis: J Annala

-- ? shifts

-- New BLT analysis program to be written. In addition to TBT injection oscillations, will calculate synchrotron oscillations, quadrupole oscillations, fast beam loss, and possibly in the future coupling and chromaticity (from decoherence time). Also, set up gates on E1/E2 BPM's to see injected coalesced pbars when protons are in the machine

-- *to be specified by J. Annala*

### Commission new SBD: R. Moore

-- ?

-- Next generation SBD under construction by R. Moore. Will try for 10% accuracy on longitudinal emittance, 5% accuracy on bunch length.

-- *to be specified by R. Moore*

Commission Pbar tunemeter: CY Tan

-- ?

-- Current tunemeter works, but signal-to-noise is poor and tickler blows up the beam. We need to find a way to improve signal-to-noise in this system.

-- *to be specified by CY Tan*

Develop chromaticity measuring technique from Schottky spectra: ??

-- several shifts (?)

-- This looks hard, but it would save a lot of time during startups. Paper written by D. McGinnis describes one method. There may be other methods. No guarantee of success here.

Commission TEL: V. Shiltsev

-- 1 shift every week

-- *to be specified by V. Shiltsev*

Investigate pbar helix momentum aperture limit M Church, Tev group

-- 4 shifts

-- Measure momentum aperture on pbar helix: use uncoalesced beam; scrape down with E0COL1; open pbar helix; knob VFKNOB to point of losses (both directions); use LM's to locate aperture restriction. Verify with local bumps. Repeat on proton helix. Redo pbar injection orbit

Investigate LBSEQ 13→14 pbar losses M Martens

-- several shifts

-- Reduce time for step: current step is 5 sec; may be limited by how fast B17 separators can change. Try different solutions for pbar tune using feeddown circuits. First must characterize behavior of feeddowns in this step. Investigate possibility of injecting on collision helix.